

THE CHROMOSOMES OF AUSTROBAILEYA

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THE PHYLOGENETIC RELATIONSHIPS AMONG the families of the primitive Ranales of Engler and Prantl have been of great interest to systematic botanists. A comprehensive knowledge of this group is vital for an understanding of the evolution of early angiosperms. The relative taxonomic position of the families and their included genera within the Ranales has been difficult to determine primarily because the primitive characteristics of these plants are often paired with advanced or reduced specialized ones. To the present, a majority of studies on the group has been concerned with and based on macroscopic observations and on anatomical-morphological features. Now, it is important to supplement this information by an investigation of the chromosome numbers and karyotypes of some of these plants.

No karyological studies exist for some of the families of this complex. No chromosome counts have been published for any members of the Amborellaceae, Austrobaileyaceae, Gomortegaceae, Gyrocarpaceae, and Trimeniaceae (Raven & Kyhos, 1965). The present note is a report on the chromosome number and karyotype of *Austrobaileya*.

Plants of *Austrobaileya* were first collected in 1929 by Kajewski in Northern Queensland. White (1933) described *A. scandens* from this material. From the beginning, the taxonomic position of this plant posed difficult problems. It was studied by White (1933, 1948) and Croizat (1941, 1943) and its taxonomic position was changed several times. Bailey and Swamy (1949) discussed the merits of these changes on the basis of detailed investigations on the morphology and anatomy of the plant. Their material included specimens from the two species *A. scandens* and *A. maculata* C. T. White. The genus is composed of only these two species and is placed in a separate family, the Austrobaileyaceae, which is considered an independent ranalian family with close affinity to the Monimiaceae.

MATERIALS AND METHODS

Seeds of *Austrobaileya* sp. were collected near Ravenshoe, North Queensland, Australia, *Webb & Tracy 6301*. Four seeds of this collection were sown at the Arnold Arboretum in 1964. Only one seed germinated almost a whole year later. The seedling was potted in 1965 and cuttings made in 1966.¹ It must be mentioned that there is some difficulty in

¹ The assistance of A. J. Fordham, propagator of the Arnold Arboretum, is gratefully acknowledged. The author is greatly indebted to Dr. L. I. Nevling, Jr., for his advice and reading of the manuscript.

species determination and in Bailey and Swamy's opinion there is a question "... whether there actually are two distinct species of overlapping ranges." On the basis of vegetative characteristics, our plants seem to resemble most closely the isotype of *A. scandens*; up to now these plants have not flowered.

Squashes were prepared from actively growing roots. The root-tips were pretreated for four hours in cold oxyquinoline (0.002 Mol.) or, for the purpose of comparison, in 0.05 per cent colchicine. They were fixed overnight in three parts absolute ethyl alcohol to one part glacial acetic acid, hydrolyzed in 1 N. HCl for 25 minutes, stained with leuco-basic fuchsin and squashed in diluted aceto-carmin. Slides were made permanent following the freezing technique of Conger and Fairchild (1953). Observations were made with a Zeiss phase microscope.

CYTOLOGY

A somatic chromosome number of $2n=44$ for *Austrobaileya* is shown in FIGURE 1. In the cell photographed most chromosomes are clearly visible, only one of them, probably the shortest one, lies across another chromosome of median length and is somewhat obscured. In the karyotype the homologues have been arranged in pairs, each pair in sequence according to decrease in length. The two longest pairs are approximately 8 and 6.4μ long, the shortest pair only 2.6μ .

Some of the chromosomes have a distinctive morphology and are definitely present only in duplicate. Most conspicuous in this respect is the longest pair with submedian centromere and the pair next in length, also submedian, with a long satellite. The satellite has the same width as the chromosome and is about one half as long as the chromosome arm to which it is attached. In several other cells the satellites became detached from the chromosomes at the secondary constrictions. Furthermore, there are two metacentric chromosome pairs in the somatic complement, each pair of a different length. The majority of the remaining chromosomes have subterminal centromeres. However, the proportion of short arm to whole chromosome length is not the same in all of them. A comparison of the individual lengths of some of the homologues may be slightly misleading because of the high magnification of the photograph by which small differences due to pressure and stretching are greatly multiplied. Nevertheless, based solely on observations of their similar morphology some of the subterminal chromosomes appear to be present in fours.

DISCUSSION

The chromosomes of *Austrobaileya* are highly asymmetrical and represent a specialized karyotype in their unequal size. Most woody angiosperms have small chromosomes with relatively few variations in size. The chromosomes of a number of ranalian families are generally larger



FIG. 1. ABOVE: Karyotype reconstructed from a cell of *Austrobaileya*. BELOW: This cell at mitotic metaphase with $2n = 44$ chromosomes, $\times 2,500$.

(Stebbins, 1938). Still larger chromosomes, however, of more equal size are found in Gymnosperms, Gnetales, and Cycadales. Many specialized monocots have relatively large chromosomes of unequal morphology in the same gametic complement together with much smaller chromosomes.

Such size differences are in some cases greater than those observed in *Austrobaileya*.

A chromosome count of $2n=44$ is rare among families of the ranalian complex. For two genera of the Monimiaceae this chromosome number has been reported. In pollen mother cells at meiosis the chromosomes pair to form 22 bivalents in *Laurelia novae-zelandiae* A. Cunn. (Hair & Beuzenberg, 1959). A species of the genus *Kibara* from East New Guinea has $2n=44$ chromosomes (Borgmann, 1964). No karyotype of this species has been published and, therefore, it is not yet possible to determine whether the chromosome complements of *Austrobaileya* and *Laurelia* and *Kibara* show an affinity or whether their equal numbers represent an insignificant coincidence. A similarity of karyotype and number could reflect a taxonomic relationship of these genera which would be particularly meaningful in woody plants which are cytologically more stable than herbaceous plants.

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